

Marine Physical Laboratory

AD-A280 834



4

Geostatistical Traverse of EPR Natural Lab

Peter F. Lonsdale

Final Report to the
Office of Naval Research
Grant N00014-92-J-1614
For the Period 06-1-92 - 09-30-93

DTIC
ELECTE
JUN 29 1994
S F D

MPL-U-3/94
January 1994

Approved for public release; distribution is unlimited.



University of California, San Diego
Scripps Institution of Oceanography

94-19800



94

6

20

153

REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. Agency Use Only (Leave Blank).		2. Report Date. January 1994	3. Report Type and Dates Covered. Final Report
4. Title and Subtitle. Geostatistical Traverse of EPR Natural Lab			5. Funding Numbers. N00014-92-J-1614
6. Author(s). Peter F Lonsdale			Project No. Task No.
7. Performing Monitoring Agency Name(s) and Address(es). University of California, San Diego Marine Physical Laboratory Scripps Institution of Oceanography San Diego, California 92152-5000			8. Performing Organization Report Number. MPL-U-3/94
9. Sponsoring/Monitoring Agency Name(s) and Address(es). Office of Naval Research Ballston Tower One 800 North Quincy Street Arlington, VA 22217-5660 Atten: Code 324GG			10. Sponsoring/Monitoring Agency Report Number.
11. Supplementary Notes.			
12a. Distribution/Availability Statement. Approved for public release; distribution is unlimited.			12b. Distribution Code.
13. Abstract (Maximum 200 words). Support is requested for the collection, processing, and interpretation of marine geophysical data (multibeam bathymetry, sonar images, magnetic and seismic reflection profiles) on a 1200 km-long traverse of the East Pacific Rise. Objectives were to characterize the changing roughness of the oceanic crust as it ages from 0 to 10 Ma on both flanks and accumulates sediments, and to study the different geologic histories of the two flanks which have affected their relief and structure, and the pattern and structure of the present plate boundary.			
14. Subject Terms. Multibeam bathymetry, magnetic and seismic reflections, East Pacific Rise			15. Number of Pages. 3
			16. Price Code.
17. Security Classification of Report. Unclassified	18. Security Classification of This Page. Unclassified	19. Security Classification of Abstract. Unclassified	20. Limitation of Abstract. None

Geostatistical Traverse of EPR Natural Lab

Peter F. Lonsdale

Final Report to the
Office of Naval Research
Grant N00014-92-J-1614
For the Period 06-1-92 - 09-30-93

Accession For		
NTIS	CRA&I	<input checked="" type="checkbox"/>
DTIC	TAB	<input type="checkbox"/>
Unclassified		<input type="checkbox"/>
Justification		
By		
Distribution		
Date		
Dist	Accession	
A-1		

Abstract

Support is requested for the collection, processing, and interpretation of marine geophysical data (multibeam bathymetry, sonar images, magnetic and seismic reflection profiles) on a 1200 km-long traverse of the East Pacific Rise. Objectives were to characterize the changing roughness of the oceanic crust as it ages from 0 to 10 Ma on both flanks and accumulates sediments, and to study the different geologic histories of the two flanks which have affected their relief and structure, and the pattern and structure of the present plate boundary.

Introduction

Much of the present geologic history of a spreading center can be interpreted from geophysical study of its rise flanks. Years ago it was realized that magnetic lineations and the azimuths of large fracture zones record the history of changing rates and direction of spreading. With the introduction of efficient high resolution survey tools, especially multibeam sonars, it became apparent that the shapes and patterns of medium-scale landforms, especially abyssal hills and volcanoes, contain far more information, especially on the history of rise crest segmentation. Reading the history of creation and extinction of transform and nontransform offsets, ridge propagation and offset migration, and changing patterns of magma supply, and relating this history to changes in external factors such as relative and absolute plate motion, is proving a key to understanding dynamic processes at rise crests. Also, once the geologic history of a rise has

been determined, by collecting critical data on carefully located but widely spaced tracks, a much more detailed prediction of the topography of unsurveyed parts is possible.

Research Objectives

The goal of this project was to use wide-spaced swath mapping sonars, with ancillary magnetic, gravity and seismic data, to establish the geologic history of a spreading center, and then to use that history to make quantitative predictions of the rise flank relief. This project investigated the history of the 9° N East Pacific Rise, and quantifying how that history has affected the medium-scale relief. The fully equipped ship (*Melville* with Sea Beam 2000, seismic profiler, magnetometer, etc.), manned by the P.I. and his associates, made a transit of the EPR between Clipperton and Siqueiros fracture zones, from 10 Ma crust on one flank, across the axis, to 10 Ma crust on the other flank. On the central 30% of this transect the data swath crossed the already surveyed (Sea Beam Mk.1; SeaMarc 2) ONR Natural Laboratory, where the history is well established. The objective was to obtain quantitative comparisons of the relief measured by the different swath mapping tools, and by the MPL Deep Tow multibeam (which collected data from small patches along the transect, earlier in 1992). Beyond the existing crustal-age boundaries of the Natural Laboratory, the data was analyzed for the following purposes:

1. To establish the crustal-age: sediment-thickness relationship for both rise flanks, so as to make additional seismic profiling unnecessary on future cruises.
2. To aid planning for future surveys by establishing at what age (probably about 7 Ma) abyssal hills change azimuth and become highly oblique to the present rise crest. This is a key indicator of how long the EPR crest has maintained its present pattern, and hence an important datum for investigating how the rise evolved to this pattern.
3. To conduct a slope distribution analysis, mainly by student H. Mayer using the statistical techniques of D. Smith and P. Shaw, repeating the analysis we recently did of a Costa Rica traverse. We will be particularly interested in how once -identical crust (accreted at the same time and place on the rise crest) now differs in morphology after moving down the east and west flanks and experiencing the different off- axis tectonic and sedimentary histories of the Pacific and Cocos plates.
4. To do a variogram analysis of the scales of abyssal hill roughness and how they vary with age, using statistical techniques.

Research Results

Bathymetric data of excellent quality was obtained with the new Seabeam 2000 sonar, and was used for objectives 2-4 of the previous paragraph. Seismic profiles and 3.5 KHz profiles are adequate for objective 1. The slope distribution and variogram analyses are consistent with qualitative interpretation of the variations in amplitude, linearity and wavelength of the abyssal hill relief, and these analyses will be published as part of the analysis and interpretation of the much larger data set collected from this region in 1994. The project proved most valuable as a pilot program for this larger study.

ONR/MPL REPORT DISTRIBUTION

Office of Naval Research (3)
Department of the Navy
Ballston Tower One
800 North Quincy Street
Arlington, VA 22217-5660
Atten: Joseph H. Kravitz
Code 324GG

Administrative Grants Officer (1)
Office of Naval Research
Resident Representative
University of California, San Diego, 0234
8603 La Jolla Shores Drive
San Diego, CA 92093-0234

Commanding Officer (1)
Naval Research Laboratory
Atten: Code 2627
Washington, D.C. 20375-5320

Defense Technical Information Center (4)
Building 5, Cameron Station
Alexandria, VA 22304-6145